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FURTHER BREAKTHROUGH EFFICIENCY GAINS IN RARE EARTH PROCESSING USING FJH TECHNOLOGY

- **Enhanced REE Conversion Efficiency: Achieved 93% (average) conversion of Rare Earth Elements (REEs) to chlorides,** a major improvement over prior results through refined carbo-chlorination parameters.
- **Very high Impurity Removal: ~95% reduction in key impurities** (Fe, Al, P) from REE concentrate in a simple single-step FJH process, revolutionising traditional REE processing.
- **Streamlined Process Flow:** Strengthened the technology's potential to replace traditional complex sulphuric acid roasting & purification workflows with a compact, single-step solution.
- **High-Purity REE-Chloride Production:** Achieved >90% purity product, significantly reducing complexity, downstream purification needs, and reagent use compared to traditional sulphuric acid roasting methods.
- **Challenges with Current Methods:** Incumbent REE extraction methods rely on energy-intensive acid baking and water-heavy processes, generating significant waste and environmental impact[1].
- **Path to Commercialisation:** Active discussions with industry stakeholders to explore adoption and integration of this transformative technology into rare earth supply chains.
- **Strategic Alignment:** aligns with U.S. initiatives to re-shore critical mineral refining, reduce foreign reliance, and strengthen domestic REE supply chains, supported by upcoming US administration changes.

WATCH A VIDEO SUMMARY OF THIS ANNOUNCEMENT & ENGAGE WITH MTM ***HERE***

MTM Critical Metals Limited ("MTM" or the "Company") (ASX: MTM; OTCXB: MTMCF) is excited to announce a major breakthrough in its innovative Flash Joule Heating (FJH) technology, achieving enhanced efficiencies in rare earth element (REE) processing beyond previously reported results[2] including for the highly valuable 'magnet REEs, Nd, Pr, Dy, Tb. This achievement marks a significant milestone for MTM, further reinforcing the potential to revolutionise and improve the economics and sustainability of traditional REE processing methods.

The FJH process provides a transformative alternative to traditional "cracking and leaching" methods for REE processing, which rely on energy-intensive high-temperature sulfuric acid baking and large volumes of water, generating significant gypsum waste and associated environmental and cost challenges. By producing purified REE chlorides in a single step, FJH technology offers substantial economic and environmental advantages.

MTM Managing Director & CEO, Michael Walshe, said: *"This breakthrough in REE processing simplifies rare earth extraction by producing REE-chlorides — a more valuable, easier-to-handle, and refined intermediate compared to traditional REE-sulphates. This includes the highly valuable and strategically critical magnet REEs: Nd, Pr, Dy, and Tb. Building on previous successes, it highlights the transformative potential of FJH technology to deliver higher efficiencies and a more sustainable alternative to incumbent methods. The optimisation achieved highlights our ability to not only match traditional processing methods in recovery but also remove major impurities in a single step, significantly reducing water consumption, chemical reagent usage, and the complexity of downstream refinement. The resulting economic and environmental benefits are expected to be substantial. Amid current geopolitical dynamics and the urgent need to reduce reliance on Chinese REE supply chains, MTM is well-positioned to provide a critical alternative. We look forward to advancing collaborations to bring this game-changing technology to market".*

[1] Gupta, C.K. & Krishnamurthy, N., 2005. *Extractive Metallurgy of Rare Earths*. CRC Press, Boca Raton, FL
[2] ASX:MTM announcement dated 25/11/2024, *'Breakthrough in Rare Earth Element (REE) Processing'*

Innovative Alternative Processing Route for REEs

MTM is advancing an innovative alternative processing route for REEs that has the potential to streamline production, reduce costs, and minimise environmental impact. Conventional REE production involves multiple stages — sulfuric acid cracking, leaching, and complex solvent extraction — which require significant acid, large volumes of water, and generate substantial by-products, including iron phosphor-gypsum and magnesium-rich gypsum (*Fig. 1*). MTM's proposed method leverages FJH chlorination and carbochlorination to directly convert flotation concentrate into REE chlorides (*Fig. 2*), potentially **eliminating the need for sulfuric acid cracking.**

This alternative FJH approach offers multiple potential advantages, such as:

1. **Reduced Acid Consumption**: By focusing on FJH chlorination / carbochlorination, the process could minimise or even eliminate the need for sulfuric acid, reducing overall acid handling & associated costs.
2. **Lower Water Requirements**: FJH technology could potentially lower water consumption compared to conventional leaching processes, as it may involve dry chlorination reactions, thus reducing the need for extensive water-based dissolution stages.
3. **Targeted REE Recovery**: Chlorination and carbochlorination are highly efficient processing techniques that enable the selective recovery of target metals or impurities. This approach has the potential to streamline downstream processing, offering a simpler alternative to traditional, complex solvent extraction systems.
4. **Improved By-Product Management**: By utilising FJH technology for REE extraction, this approach may significantly reduce or alter the type of by-products generated, such as minimising the production of large volumes of gypsum. This could simplify waste management and reduce environmental challenges.

By focusing on producing REE chlorides directly from flotation concentrate, MTM aims to establish a more sustainable, cost-effective pathway for REE production, positioning itself at the forefront of technological innovation in the critical minerals sector.

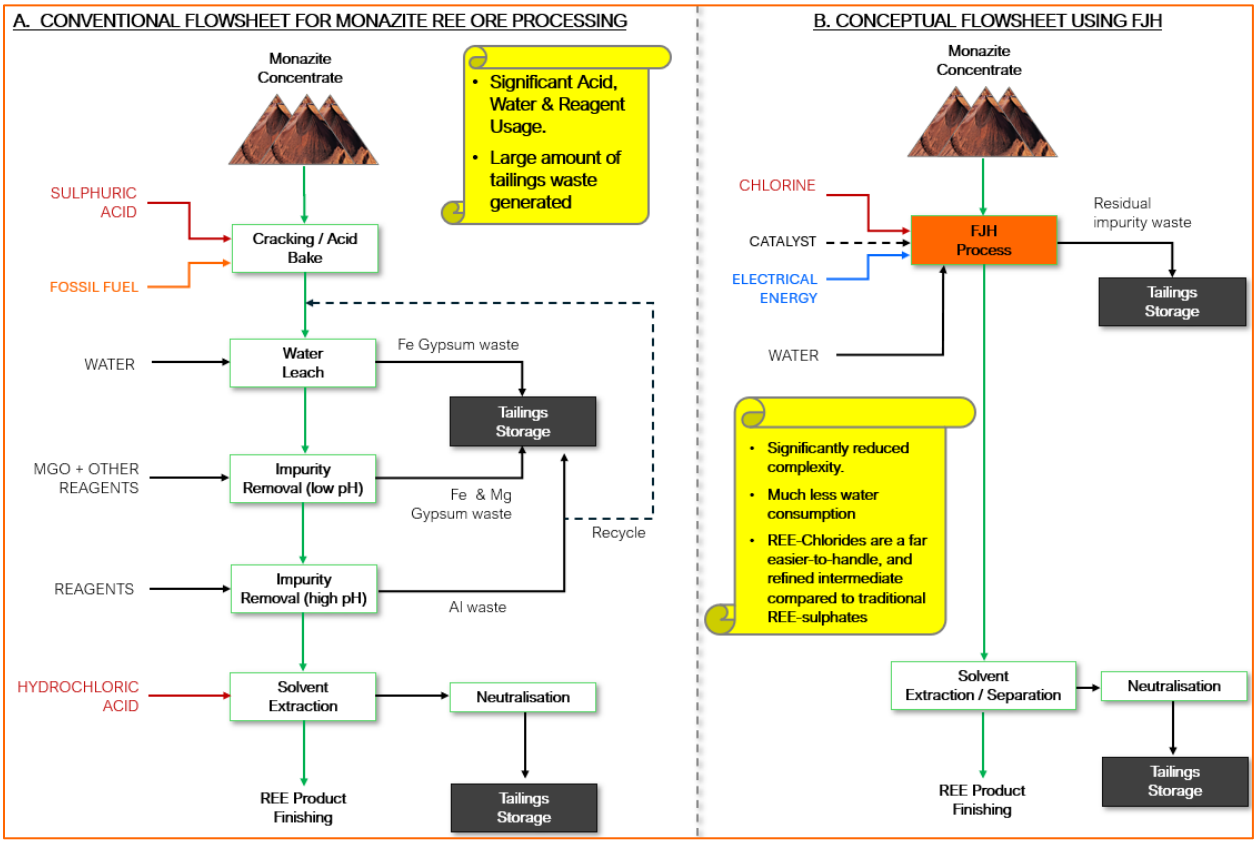

Figure 1: Simplified flowsheet comparison of conventional vs FJH process for treating monazite REE concentrate[1]

WHY THIS MATTERS

This breakthrough significantly reduces process complexity and water consumption while producing REE-chlorides, a far easier-to-handle and more refined intermediate compared to traditional REE-sulphates, offering substantial economic and operational advantages. The process has achieved exceptionally high removal efficiencies for all REEs, most notably for the **valuable magnet REEs—Nd, Pr, Dy, and Tb** — even at this early, unoptimised stage. This underscores its transformative potential for the industry and highlights the technology's strong commercial potential.

SULFATE CHEMISTRY

Monazite (REE-Phosphate) + Impurities	+	Sulphuric Acid	=	REE-Sulfates	+	Waste Byproducts Impurities

CHLORIDE CHEMISTRY

Monazite (REE-Phosphate) + Impurities	+	Chlorine	=	REE-Chlorides	+	Waste Byproducts Impurities

Figure 2: **Simplified chemistry comparison of convention vs FJH process for treating monazite REE concentrate**

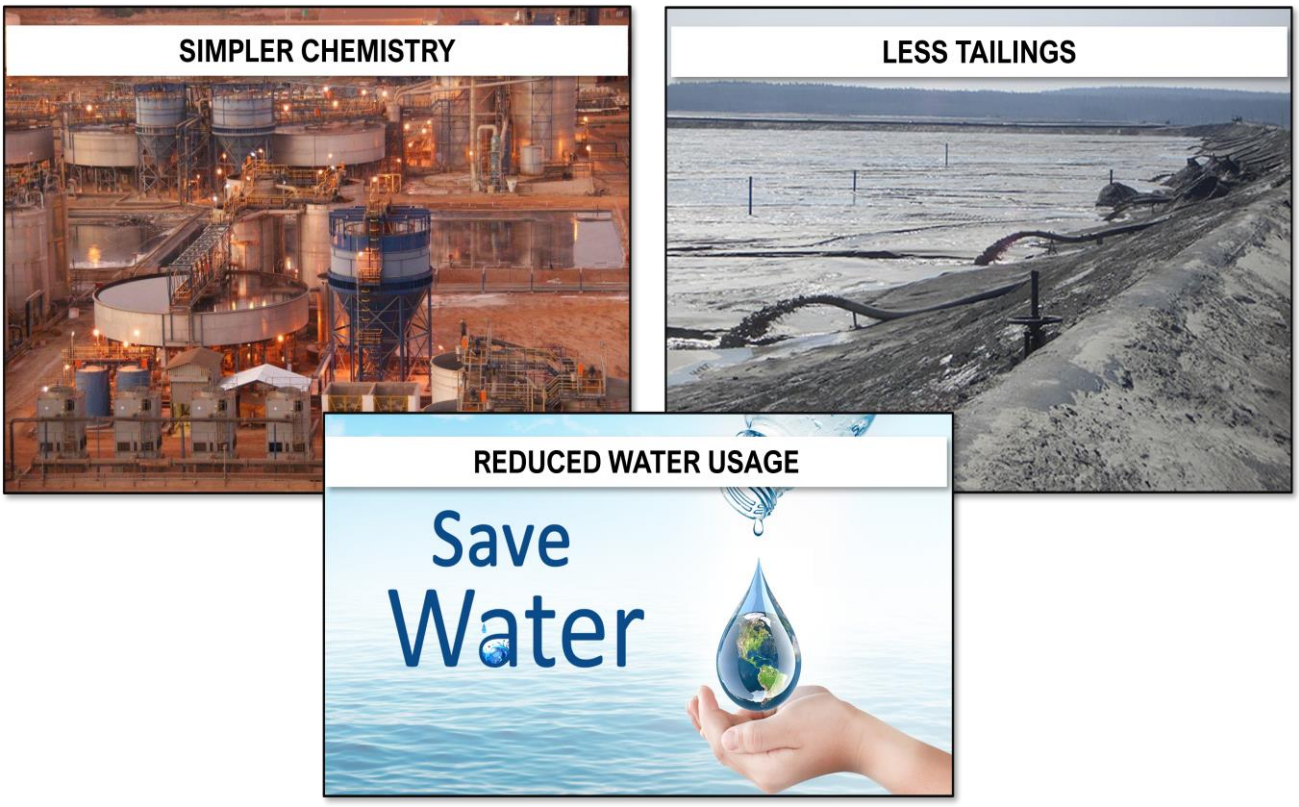

Figure 3: **Benefits of alternative FJH process for treating monazite concentrate**

Summary of Method & Results

The testing utilised FJH carbo-chlorination to treat monazite-rich REE concentrate accompanied by a water wash. The feedstock consisted of a dried flotation concentrate with ~31% (by mass) Total Rare Earth Oxide (TREO) content. This material had undergone a typical monazite concentration process, including crushing, grinding, flotation, thickening, and drying, to prepare it for further processing. Following previously reported successes[2], the latest results demonstrate significant enhancements to the FJH process:

1. **Improved REE Conversion:** A single carbo-chlorination flash converted 93% of REEs into high-purity, water-soluble chlorides. **All 17 REEs were successfully chlorinated, underscoring the robustness of the process.**
2. **Higher Impurity Removal:** Very high impurity removal rates of key deleterious elements (averaging 95%), including Fe (92%), Al (96%), and P (98%), providing scope to significantly reduce the mass of any transported concentrate material while also dramatically simplifying downstream enrichment.
3. **Refined Process Chemistry:** Further optimisation of reaction conditions has simplified the conversion of monazite phosphates to chlorides, eliminating the reliance on energy-intensive sulphuric acid baking and multi-stage leaching.
4. **A high-purity REE-chloride product (>90% purity)** was successfully produced using this streamlined and efficient process, offering a stark contrast to the highly complex, energy-intensive, and reagent-heavy traditional sulphuric acid roasting flowsheet.
5. TotalQuant Inductively Coupled Plasma Mass Spectrometry (ICP-MS)[3] was used to quantify the metals in both the solid residues and the water wash solutions. Additionally, Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM/EDS) was also employed to characterise the residual solid materials for an extra layer of analysis.
6. The EDS analysis of the remaining solids showed that there has been a significant purification of the feedstock, with the majority of the remaining solids (post flash residue) being composed of REEs plus chlorine, in the form of REE chlorides. Additionally, the vast majority of the impurities such as Fe, Al Ca, P, were removed the remaining solids, which were subsequently water washed to extract the REE-chlorides.

Table 1: Overall summary of REE-Chloride conversion yields for the key REE elements of interest (mass basis)

REE Element	Nd	Pr	Dy	Tb	Ce	La	Eu	Gd	Y	Sm
REE % Conversion to Chloride (±10%)	90%	100%	77%	89%	90%	93%	100%	100%	79%	96%

Table 2: Key Contaminant Removal Fraction (mass basis)

Contaminant Element	Al	Fe	P
Removal Rate (±10%)	96%	92%	98%

[3] TotalQuant refers to a mode in ICP-MS where all measurable elements are detected and quantified in a single run without prior specific selection of elements. This is particularly useful for complex samples where a comprehensive elemental profile is required. It is considered qualitative (or semi-quantitative) (±20% accuracy) because, in the TotalQuant mode, it provides a broad overview of the elements present in a sample without the rigorous calibration that would be needed for fully quantitative results & does not account for possible elemental interferences between various metals.

Figure 4: **Photos of (A) Pre-Flash Sample of Feedstock (Flotation Concentrate) (RHS) with carbon (LHS), & (B) High purity REE-chloride product (>90% purity) produced from water-washing the post flashed solids**

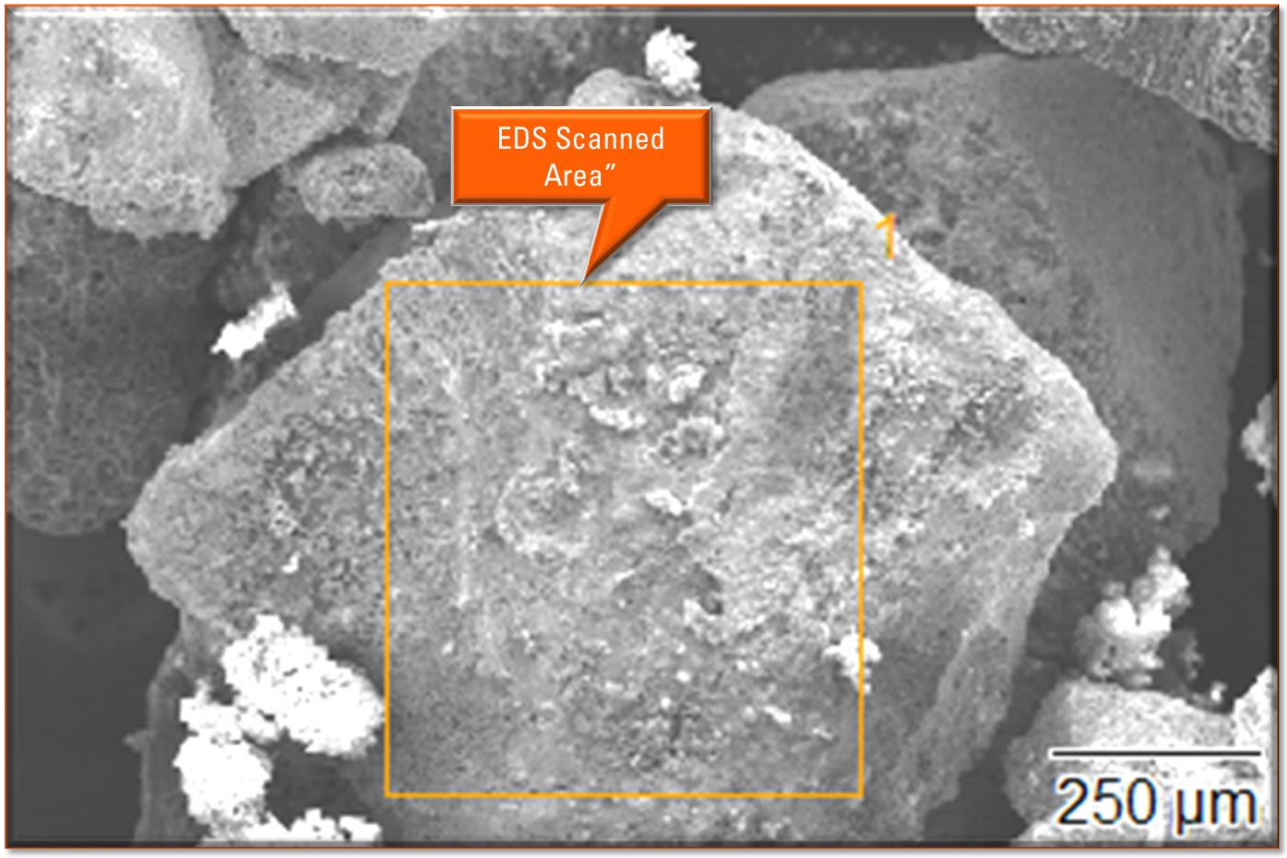

Figure 5: **SEM Micrograph of remaining solids showing the EDS scanned area showing almost pure REE-chlorides**

Path to Commercialisation

With these advancements, MTM continues to focus on accelerating the pathway to industrial-scale deployment:

1. **Continued Optimisation:** Refining key process parameters, including reaction kinetics, particle size distribution, reagent addition rates and temperature.
2. **Scaling Up:** Progressing towards pilot-scale trials to validate industrial applicability.
3. **Industry Collaboration:** Ongoing discussions with industry stakeholders to foster adoption and expand market integration.

MTM continues to advance the design and implementation strategy of its Texas-based demonstration processing plant, focused on demonstrating the commercial viability of the technology across diverse feedstocks and metal applications. This initiative also supports the reshoring of critical metals refining to the US, addressing key national security and supply chain challenges.

Fig 6. FJH Pilot / Demonstration Plant

Upcoming Newsflow Throughout 2025

MTM is poised for an exciting year ahead, with a strong pipeline of updates expected throughout 2025. Key milestones include the completion of the FJH demonstration plant design by February, followed by procurement, construction, and commissioning phases. In parallel, ongoing testing programs across multiple critical metal feedstocks, such as rare earths, lithium, and e-waste, will deliver further validation of the technology. Strategic partnerships, non-dilutive funding updates, and progress toward binding offtake agreements will also feature prominently as MTM advances its commercialisation strategy and builds momentum toward revenue generation.

A Strategic Move Towards a U.S.-Based Rare Earth Supply Chain

Separating rare earth elements (REEs) is a significant technical challenge due to their chemical similarities and the fact that they are typically bonded together in mineral deposits. Traditional separation methods, such as solvent extraction, are complex, costly, and environmentally taxing, requiring hundreds of stages to achieve high-purity REEs. This complexity has historically driven reliance on overseas supply chains, where processing has been more cost-effective.

As geopolitical tensions rise and the strategic importance of REEs in defence, electronics, and renewable energy becomes clear, the U.S. is prioritising the onshoring of rare earth processing and supply. Policies and funding initiatives now incentivise domestic extraction, processing, and recycling to reduce foreign dependence and enhance self-sufficiency in critical materials.

MTM's breakthrough FJH technology addresses key challenges in sustainable production and supply chain security by producing purified REE chlorides directly from flotation concentrates. This streamlined process reduces environmental impact, simplifies refining, and makes REEs more accessible for key industries like renewable energy, advanced manufacturing, and defence.

This progress aligns with U.S. efforts under the incoming Trump administration to strengthen domestic supply chains, reduce reliance on foreign processing, and support innovative technologies. Notable initiatives include a US$35 million **Department of Defense (DoD)** award to MP Materials for rare earth oxide processing and a US$4 million DoD grant to Rare Earth Salts for expanding terbium oxide production from recycled materials[4,5]. These efforts highlight the government's commitment to building a robust domestic REE supply chain.

MTM's FJH technology offers a timely and impactful solution, enabling streamlined, sustainable REE processing and supporting U.S. objectives to enhance economic security, advance technological leadership, and create high-value manufacturing jobs. Discussions are underway to integrate MTM's advancements into this strategic vision.

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This announcement has been authorised for release by the Board of Directors.

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[4] https://www.defense.gov/News/Releases/Release/Article/2941793/dod-awards-35-million-to-mp-materials-to-build-us-heavy-rare-earth-separation-c/#:~:text=The%20Department%20of%20Defense%20(DoD,Mountain%20Pass%2C%20California%20production%20site.

[5] https://www.defense.gov/News/Releases/Release/Article/3898948/department-of-defense-awards-422-million-to-increase-production-of-terbium-and/#:~:text=The%20Department%20of%20Defense%20announced,in%20many%20key%20defense%20systems.

ABOUT MTM CRITICAL METALS LIMITED

MTM Critical Metals Limited, is an ASX & OTCQB-listed company with management teams in Perth, Western Australia, and Texas, USA, and specialises in advanced metal recovery technologies. MTM's 100%-owned USA subsidiary **Flash Metals USA Inc** is based in Texas, USA. MTM possess exclusive licensing rights to the innovative *Flash Joule Heating technology*, a cutting-edge metal recovery and mineral processing method developed by esteemed researchers at Rice University, USA. Additionally, MTM holds exploration assets prospective for niobium (Nb), rare earth elements (REE), and gold, strategically located in Western Australia and Québec.

- Flash Joule Heating (FJH) is an advanced electrothermal process that enhances metal recovery and mineral processing compared to traditional methods. By rapidly heating materials in a controlled atmosphere, FJH efficiently extracts metals like lithium from spodumene, gallium from scrap, and gold from e-waste, among others. This technology has the potential to revolutionise metal recovery by reducing energy consumption, reagent use, and waste, offering a more economical and environmentally friendly alternative.

- MTM's West Arunta Nb-REE exploration assets are situated in one of Australia's premier exploration hotspots, where over $60 million has been invested by ASX-listed companies such as WA1 Resources, Encounter Resources, Rio Tinto (in JV with Tali Resources), and IGO Limited. MTM also holds tenements in other key mineral regions across Western Australia, including the Mukinbudin Nb-REE Project, East Laverton Gold & Base Metals Project, and Mt Monger Gold Project. In Québec, the Pomme Project is a highly promising carbonatite intrusion rich in REE and niobium, located near the world-class Montviel deposit.

To learn more, visit:

Website: https://www.mtmcriticalmetals.com.au/

MTM's Investor Hub: https://investorhub.mtmcriticalmetals.com.au/

PREVIOUS DISCLOSURE

The information in this announcement is based on the following MTM Critical Metals Limited ASX announcements, which are all available from the MTM Critical Metals Limited website www.mtmcriticalmetals.com.au and the ASX website www.asx.com.au.

Date	Description
25 November 2024	Breakthrough in Rare Earth Element (REE) Processing'

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original ASX announcements and that all material assumptions and technical parameters underpinning the relevant ASX announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are represented have not been materially modified from the original ASX announcements.

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